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A COMPREHENSIVE APPROACH TO MANAGEMENT OF WORKPLACE AND ENVIRONMENTAL NOISE AT NASA LEWIS RESEARCH CENTER

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INTRODUCTION

NASA Lewis Research Center, located in Cleveland, Ohio, is a lead NASA center for research, technology, and development of aircraft and space propulsion, space power systems, and satellite communications. The 4600-person workforce includes 2600 civil servants as well as employees of 45 on-site support-service contractor organizations.

Located on 360 acres adjacent to Cleveland Hopkins International Airport, Lewis Research Center's 150 buildings comprise a variety of individual noise sources and employee exposure scenarios, some of which also occasionally affect surrounding residential communities. More than 100 experimental research testing facilities and laboratories, including large wind tunnels and engine test cells, create a varied and complex noise environment. A central process air system supplies test cells with compressed air and vacuum, provided by diverse compressors and exhausters, along with turboexpanders, heaters, dehydrators, and other auxiliary equipment. Much of this equipment was manufactured prior to the enactment of legislation limiting product noise emissions or occupational noise exposure.

Nearly 100,000 ft² of metalworking and specialized fabrication shops located on-site produce small scale prototypes, models, and small parts as well as large scale structural test hardware in support of experimental research operations. Routine facility maintenance and associated construction, along with construction of new buildings and facilities, also contribute to a noise exposure management responsibility which is equal in magnitude and scope to that of several small industrial companies.

NOISE PROGRAM MANAGEMENT

Centrally managed within the Office of Environmental Programs in partnership with a number of other Lewis Research Center organizations, the Noise Program maintains overall responsibility for hearing conservation, community noise control, and acoustical and noise control engineering. The Noise Program Manager, assisted by technical and administrative support personnel, is responsible for the development and implementation of standards, policies, and procedures to limit employee noise exposure, assure regulatory

compliance, and maintain the support of neighboring communities. The Noise Program strives to meet its key goal of facilitating research via safe, pragmatic, and cost-effective solutions to noise issues by stressing implementation and service above oversight or enforcement.

Centralized management of the Lewis Research Center Noise Program facilitates the timely development and implementation of engineered noise control solutions for problems identified via either the Hearing Conservation or Community Noise Program. The key element of the Lewis Research Center Noise Program, Acoustical and Noise Control Engineering Services, is focused on developing solutions that permanently reduce employee and community noise exposure and maximize research productivity by reducing or eliminating administrative and operational controls and by improving the safety and comfort of the work environment.

HEARING CONSERVATION PROGRAM

The Hearing Conservation Program, comanaged with Lewis Research Center's Occupational Medicine Services, provides noise exposure assessment, medical monitoring, and training for more than 540 civil servant and contractor employees. The Program incorporates the requirements of 29CFR 1910.95, the Occupational Safety and Health Administration (OSHA) standard on occupational noise exposure, but requires employees to wear personal hearing protection equipment when working in areas where noise levels exceed 85 dB(A), independent of exposure duration. The action level for employee enrollment in medical monitoring and training programs is an 8-hour time-weighted-average (TWA) A-weighted sound level of 80 dB, 5 dB below the OSHA action level of 85 dB(A) (TWA). This conservative approach relies on time-weighted average exposure limits only as a default in extreme high noise environments where dual hearing protection is insufficient to limit the employee's exposure to 85 dB(A) (TWA), significantly simplifying the task of tracking and managing employee exposures. Because of the increased protection afforded employees, trade-offs are possible, where appropriate, between hearing protection requirements and research or operational constraints.

Noise exposure assessments are required as a condition of the operating permit of every research facility and process that has the potential for generating high levels of noise. A significant advantage of centralized management of the Noise Program is that it allows potential community noise impact to be considered along with employee exposure during the evaluation of any facility operation. Noise surveys are also performed as a means of responding to employee complaints or concerns about workplace noise exposure and in response to referrals from Lewis Research Center's Occupational Medicine Services. Realistic and practical noise control engineering recommendations are a key product of most noise surveys.

Employee enrollment in medical monitoring and training programs, facility-specific requirements for personal hearing protection, and noise control engineering recommendations, where appropriate, are the usual outcomes of noise exposure assessments. This holistic approach facilitates informed trade-offs among available solutions, which usually include one or more engineered noise control options as well as

the alternative--management of a more extensive hearing conservation or community noise program. In many high noise areas, multiple, complex, or distributed noise sources render retrofit or source noise control economically and physically impractical. Pending the eventual replacement of equipment, the most cost effective approach is usually a hybrid involving some type of personnel enclosure (e.g., control room or office) together with personal hearing protection and employee enrollment in medical monitoring and training programs.

COMMUNITY NOISE PROGRAM

The proactive Community Noise Program aims to maintain the support of Lewis Research Center's neighboring communities while enabling necessary research operations to accomplish their programmatic goals. Although Lewis Research Center facilities have been responsible for an occasional community noise complaint, the large majority of complaints received are the result of maintenance run-up operations at neighboring Cleveland Hopkins International Airport. Airport-related complaints present a unique challenge because of the limited strategies available to Lewis Research Center for resolving them.

All complaints are addressed personally by the Noise Program Manager. Noise complaints received during second and third shifts are relayed via pager by the Lewis Research Center Fire Department after investigating the status of Lewis facility operations. This information, together with the complainant's description of the noise, enables a clear determination of which, if any, Lewis Research Center facility is responsible for the complaint.

When contacted by the Noise Program Manager, the complainant is encouraged to provide a complete description of the noise, including start and stop times, spectral and temporal characteristics, and apparent source direction, as well as any other information that may be helpful in identifying the source, such as previous occurrences of the same noise. The Noise Program Manager offers information about any LeRC facilities that are or were known to be in operation at the time(s) the noise was heard and what that particular noise typically sounds like in the community. When correlated with facility operating parameters, data from complaints that do arise as a result of a Lewis Research Center operation may be scientifically incorporated into the development of prioritized, cost-effective noise control solutions. If a complaint is clearly unrelated to the operation of any Lewis Research Center facility, the goal is to help the complainant realize, on the basis of data from research logs and central process air system records as well as noise characteristics, that the source of the noise is other than a Lewis Research Center facility.

Immediate, personalized response to all complaints, coupled with a scientific approach to investigating complaints in real time, has proven to be a successful approach that allows Lewis Research Center to demonstrate its responsiveness and good-neighbor attitude while maintaining a cooperative working relationship with Hopkins Airport. These and other outreach activities of the Noise Program are part of an overall proactive community relations effort that has ensured uninterrupted 24-hour operation of key facilities, facilitating the timely accomplishment of research goals.

ACOUSTICAL AND NOISE CONTROL ENGINEERING SERVICES

Through centralized management of the Noise Program, the outcome of any employee noise exposure assessment may include noise control recommendations. Likewise, repeated community noise complaints that are received in response to a particular Lewis Research Center facility operation provide an incentive, if not a directive, for noise control engineering of the offending source. The prioritization, funding, planning, and implementation of noise control projects is facilitated immensely by the fact that noise control engineering capability resides within the Noise Program.

Noise Program personnel provide a variety of acoustical and noise control engineering services to support planning and design efforts for new test facilities, laboratories, and office buildings. For new test cells and large facilities where combustion air exhaust or venting is likely to create high levels of environmental noise, empirical and theoretical computer models may be used to predict source noise as well as the resulting employee and community exposure. Noise control engineering, based on specific exposure limits, then becomes a fundamental consideration throughout the design phase. With the goal of improving safety and increasing productivity, a significant percentage of Noise Program resources are directed toward lowering office and control room noise levels to reduce speech interference and improve communication, especially during research testing. Because the continual expansion of Cleveland Hopkins International Airport has contributed significantly to the outdoor noise environment, design efforts aimed at limiting noise in interior spaces involve consideration of the external noise environment as well as sources internal to the building.

The Noise Program Manager also serves as a resource to in-house and external organizations. Limited acoustical testing services and equipment are available on request to Lewis Research Center engineers in support of acoustical test requirements for space flight hardware, diagnostic evaluations of research equipment problems, and verification of purchased components or systems against contractual specifications for noise emissions. Consulting services are provided to other Government, military, commercial, and community organizations through the Lewis Research Center External Programs Directorate as a means of sharing technical information and experience gained from solving noise problems at Lewis Research Center.

SUMMARY

Workplace and environmental noise exposures at NASA Lewis Research Center are effectively managed via a three-part program that addresses hearing conservation, community noise control, and acoustical and noise control engineering. The centrally managed program seeks to limit employee noise exposure and maintain community acceptance for critical research while actively pursuing engineered controls for noise generated by more than 100 separate research facilities and the associated services required for their operation.